

REMARKS/ARGUMENTS

Claims 1-28, 33-51, 53, 54, 56-60, 62, 64, 65, 67, 68, 77-84, 86-88 and 90-96 remain in this application. Claims 1, 7, 16, 18-20, 33-24, 26, 27, 43-48, 50, 60, 62, 80 and 81 have been amended to more clearly recite the limitation inherently expressed therein that the perimeter be of the image of the golf ball. These amendments are therefore not believed to narrow the scope of the claims so amended.

Applicant acknowledges with appreciation the examiner's attempt to clarify matters not completely understood by prior patent counsel. Applicant apologizes for any statements made by prior counsel with which the Examiner may have taken offense.

The examiner rejected claims 1-28, 33-51, 53, 54, 56-60, 62, 64, 65, 67, 68, 77-84, 86-88 and 90-96 as being unpatentable under 35 USC 103 over various combinations of Gobush et al. (US 5,803,823) ("Gobush '823"), Gobush et al. (US 6,241,622) ("Gobush '622"), Sullivan (4,158,853) ("Sullivan"), Bouton (US 5,472,205) ("Bouton"), Mook (US 5,067,719), Katayama (US 6,042,483) ("Katayama"). Each of the claims was rejected as being unpatentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in yet further view of Bouton

It is respectfully submitted that the Examiner, while presenting arguments in support of his rejections, has nevertheless failed to establish a prima facie case of obviousness of any of the rejected claims.

A. Claims 1-11, 33, 57-60, 65 and 67-68 are patentable over the cited references

The Examiner rejected claims 1-11, 33, 57-60, 65 and 67-68 as being unpatentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in yet further view of Bouton. This rejection relates to independent claims 1, 7, 60 and certain of the claims depending therefrom. Thus, if the cited combination of references does not disclose each and every element of the independent claims, or if there is no motivation or suggestion to combine the references, a prima facie case of obviousness has not been established.

1. **The cited references fail to disclose extrapolation of perimeters of the image of the golf ball as recited in each of the rejected independent claims and the rejected dependent claims.**

Claim 1, as amended recites:

1. An apparatus for monitoring a swing path and/or a golf club head angle at or near an impact location with a golf ball during a golf swing, comprising:
 - a golf ball impact location for receiving a golf ball;
 - a first array of sensors proximate to the impact location;
 - a second array of sensors spaced apart from the first array behind the impact position along a swing path, the first and second array positioned such that a golf club swung in preparation for contact with a golf ball at the impact location will have a swing plane in angular relation to the first and second arrays;
 - an image capture device **consisting essentially of a single camera** for capturing two or more images of the golf ball after impact with the golf club head; and
 - a processor for receiving signals indicative of a temporal profile of which sensors the golf club head is over during the swing and for determining at least one of a swing path and a club head angle of the golf club based on said signals indicative of the temporal profile, the processor further for determining three-dimensional velocity of the golf ball by extrapolating perimeters of the image of the golf ball in two or more images taken using the camera, and by determining three-dimensional spatial positions of the ball in said images and calculating the three-dimensional velocity of said golf ball based on said three-dimensional spatial positions.

Claim 7, as amended, recites:

7. An apparatus for monitoring a golf club head angle at or near an impact location of the club head with a golf ball during a golf swing, comprising:
 - an array of sensors arranged at an angle to a plane of a golf swing of a golf club head;
 - an image capture device **consisting essentially of a single camera** for capturing two or more images of a golf ball after impact with the golf club head; and
 - a processor for receiving signals indicative of a temporal profile of which sensors the golf club head is over during the swing and for determining a club head angle of the golf club based on the signals indicative of the temporal profile, the processor further for determining

three-dimensional displacement of the golf ball by extrapolating perimeters of the image of the golf ball in two of more images taken using the camera, by determining three-dimensional spatial positions of the ball in said images and calculating the three-dimensional displacement of said golf ball based on said three-dimensional spatial positions.

Claim 60, as amended, recites:

60. An apparatus for determining ball velocity in three dimensions of a golf ball after impact with a golf club head, comprising:
an **image capture device consisting essentially of a single camera** for capturing two or more images of the golf ball after impact with the golf club head; and
a processor connected with said image capture device for calculating a three-dimensional ball velocity by determining circumferential extrapolations of perimeters of the image of the golf ball in two or more images obtained only by using the camera, by automatically determining and comparing three-dimensional spatial positions of the image of the golf ball in said two or more images, and by calculating three-dimensional velocity using said three-dimensional spatial position determination and comparison.

The Examiner argues that Gobush '622 teaches an image device including a camera (36, 38) for capturing two or more images of the golf ball after impact . . . and a processor for receiving signals indicative of a temporal profile and three dimensional velocity of the golf ball by **extrapolating perimeters** of two or more images taken using the camera, and by determining three-dimensional spatial positions of the ball in said images and calculating the three dimensional velocity based on said three-dimensional spatial positions (Abstract, Col 8:39-42, Col 10:10-17, Col 13:45-50)." Office Action at pg. 3, ll. 3-9. Gobush '622 does not teach extrapolating perimeters of the images of the golf ball in order to determine the temporal profile, three dimensional velocity or three-dimensional spatial orientation.

Examination of the specific citations relied upon by the examiner to establish that Gobush "extrapolates perimeters" clearly establishes that no such extrapolation occurs in Gobush. For Example, the Abstract recites:

A launch monitor system including a support structure, a first light-reflecting element disposed on this support structure, a lighting unit and a camera unit. A computer receives signals generated by light patterns received by the camera unit and computes a variety of flight characteristics for the object. The system may be moved back and forth to vary the field-of-view of the camera unit. The system also computes and displays object trajectories from the computed flight characteristics which account for the characteristics of the object and the atmospheric conditions. Gobush '622; Abstract

This quotation mentions nothing about perimeters of the image of the golf ball. Gobush '622; Col 8:39-42 states "If only twelve dots are found in the image, the system moves on to step S107 to determine, from the dots in the images, the position and orientation of the golf ball during the first and second images." This again mentions nothing about extrapolation of perimeters. Gobush '622; Col 10:10-17 is a chart showing "[a]n exemplary set of these three dimensional positions for right hand calibration for the calibration fixture with 15 dots". Gobush '622; Col 10:7-9. Again, no mention of extrapolating perimeters. Gobush '622; Col 13:45-50 is a set of equations for determining "the velocity components of the center of mass V_x , V_y , V_z along the three axes of the global coordinate system". Gobush '622; Col 13:42-43. Again no mention of perimeters.

Although none of the citations provided by the Examiner establishes that Gobush '622 extrapolates perimeters of the image of the ball as recited in each of independent claims 1, 7, , it is well settled that a prior art reference should be examined for what it teaches as a whole. Gobush '622, when read as a whole, teaches extrapolating three dimensional velocities and positions of the ball from the "position of the dots in the images" while ignoring the perimeter of the golf ball in the image.

Gobush '622 uses at least two cameras that have been calibrated using a calibration fixture so that through triangulation the location in space of any dot appearing in the frame of both cameras can be determined, rather than extrapolating information regarding the perimeter of the image of the golf ball to obtain one of the three coordinates of the center of the golf ball. In fact, Gobush '622 does not even desire to look at the perimeter of the image of the golf ball but only at the reflective dots attached to the golf

ball. The disclosure of Gobush '622 indicates that any object that cannot with some certainty be identified as a reflective dot is ignored by the software by the following language:

At step S133, the system eliminates those areas of brightness in the image that have an area outside a predetermined range. Thus, areas that are too large and too small are eliminated. In the preferred embodiment, the dots on the golf ball are $\frac{1}{4}$ " – $\frac{1}{8}$ " and the camera has 753 x 244 pixels, so that the dots should have an area of about 105 pixels in the images. However, glare by specular reflection, including that from the club head and other objects, may cause additional bright areas to appear in each of the images. Thus, if the areas are much less or much more than 105 pixels, then the system can ignore the areas since they cannot be a marker on the ball." Gobush '622, col. 12, ll. 8-20.).

Preferably the light sensitivity setting of the camera is adjusted so that **only reflective spots** can generate white pixels on the image of the camera. ("By setting the correct threshold level for the image to a predetermined level, all pixels in the image are shown either as black or white." Gobush ' 622, col. 11, ll. 32-35; "However, if there are more or less than twelve dots or bright areas found in the images, then at step S108 the system allows the operator to manually change the images. If too few bright areas are located, the operator adjusts the image brightness, and if too many are present, the operator may delete any additional bright spots." Gobush '622 col. 8, ll. 42-48.) Thus, Gobush seeks to eliminate data regarding the golf ball perimeter in the images of the golf ball from the calculation of three dimensional position and velocity and even seeks to eliminate the perimeter of the golf ball from the images captured.

Like Gobush '622, Sullivan relies on reflective spots placed on the golf ball to provide bright spots in images captured and the X/Y position of these bright spots in the images for determination of the 3-D velocity of the golf ball. Sullivan; Col 2, ll63-68, Col 3, ll 20-41, Col 5, ll3-6 and 34-38, Col 6, ll 24-31 and Col 7, ll 19-34. Also like Gobush '622, Sullivan suppresses "all other scene elements not having retroreflective enhancement". Sullivan: Col 6, ll 10-11. Neither Sullivan nor Gobush '622 extrapolate perimeters of the image of the golf ball as required by independent claims 1, 7 and 60, on

the contrary, both references specifically teach suppressing or ignoring the perimeter of the golf ball in the images captured.

As indicated by the Examiner, Gobush '823 does not teach specific tracking of the golf ball as its focus is on club head position. Similarly, Bouton focuses on determining club head position and does not track or record images of the golf ball after club head impact.. Thus, none of the references, either alone or in combination, cited for the rejection of claims 1-11, 33, 57-60 and 67-68 teaches or suggests all of the elements of the rejected claims. Since a prima facie case of obviousness has not been established, the rejection of claims 1-11, 33, 57-60 and 67-68 should be withdrawn.

While there may be a temptation to find a reference which teaches capturing of the entire image of the golf ball, including the perimeter, to combine that reference with Gobush '823, Gobush '622, Sullivan and Bouton to provide the missing element recited in the rejected claims, such a combination would be improper. As discussed above, Gobush '622 and Sullivan, by teaching suppression of all data except data relating to the position of retroreflective spots in captured images, clearly teach away from combining their disclosures with any disclosure teaching the capture of the entire image of the golf ball, including the perimeter.

2. The cited references fail to teach an image capture device consisting essentially of a single camera for acquiring three dimensional data.

The Examiner indicated that "the language 'consisting essentially of a single camera' fails to limit the use of multiple cameras". This simply is not in accordance with well settled patent law principles. "By using the term 'consisting essentially of,' the drafter signals that the invention necessarily includes the listed ingredients and is open to unlisted ingredients that do not materially affect the basic and novel properties of the invention. A 'consisting essentially of' claim occupies a middle ground between closed claims that are written in a 'consisting of' format and fully open claims that are drafted in a 'comprising' format." *PPG Industries v. Guardian Industries Corp.*, 156 F.3d 1351 at 1354, 48 USPQ2d 1351 at 1353-1354 (Fed. Cir. 1998).

The Examiner, for the sake of furthering prosecution then indicated that Sullivan teaches the use of a single camera in figure 2 for the capture of post impact ball flight characteristics. Sullivan states that "Fig. 2 shows a block diagram of one of the measuring cameras and its associated devices." Sullivan: Col 3, ll 5-6. This statement indicates that Sullivan teaches the use of multiple cameras (identified as cameras 20, 20a and 20b) for implementation of the disclosed invention and that Fig. 2 only shows one of the multiple cameras. Thus, Fig. 2 does not teach using a single camera.

Nevertheless, Sullivan states that:

Although a three-camera measurement system is shown, other numbers of cameras may be used. For example, most of the data can be taken using a single TV camera, for example, camera 20 and a plurality of enhanced spots on the ball. Although the ability to measure displacement and spin of the ball 10 out of the plane of observation is limited in a one-camera system, the accuracy can be made satisfactory for some applications. Sullivan; Col. 3, ll 46-54.

Sullivan nowhere else in the application teaches an embodiment utilizing a single camera, nor does Sullivan disclose what types of applications a single-camera might be suitable for. Since Sullivan teaches suppressing all data other than the X/Y coordinates generated by the retroreflective spots in the captured images, it seems impossible for that data to supply sufficient information to provide three dimensional velocity and spin information. The accuracy of a Sullivan single-camera system might be able to be made satisfactory for equipment testing devices that present the face of the club perpendicular to the desired flight path with the club face passing along the desired flight path. However, in such an arrangement, since the flight of the ball is constricted to the desired vertical plane along the flight path, such a system would not calculate three dimensional position, velocity or spin. Sullivan teaches away from increasing the accuracy of a single camera system by capturing a plurality of images of a golf ball in flight including images

of the perimeter of the golf ball from which motion in the plane of the camera can be determined.

With multiple cameras, it is much easier to detect movement in all three dimensions because each camera views the image from a different perspective. If the cameras are not in a plane parallel to the vertical plane along the desired flight path, each camera then has a different angular relation with respect to the plane of flight and can detect movement out of the anticipated plane of flight simply by noting the location of the center, or any other predetermined location of the ball. For instance, with the arrangement shown in Fig. 1 of Sullivan, movement out of the vertical plane along the desired flight path can easily be determined by sideways movement of the center of the image of the ball captured by either camera 20a or camera 20 b. Vertical movement can be determined based on movement of the center of the ball in the image captured by any of the three cameras 20, 20a or 20b, movement downrange is best captured using movement of the center of the ball in the image captured by camera 20.

With a single camera only a single perspective, i.e. a single view plane, is provided. Thus, simply determining the coordinates of the center of the ball in each image will provide no indication of movement toward or away from the camera. However, determining the relative size of the ball in each image does provide information from which the position relative to vertical plane along the anticipated line of flight. As the relative size of the ball gets bigger, the ball is moving toward the camera out of the vertical plane along the anticipated flight path. Alternatively if the relative size of the ball

gets smaller, the ball is moving away from the camera out of the vertical plane along the desired flight path.

Thus, none of the references, either alone or in combination, cited for the rejection of claims 1-11, 33, 57-60 and 67-68 teaches or suggests all of the elements of the rejected claims. Since a prima facie case of obviousness has not been established, the rejection of claims 1-11, 33, 57-60 and 67-68 should be withdrawn.

B. Claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 are patentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in further view of Bouton in yet further view of Mook.

The Examiner rejected claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 as being unpatentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in further view of Bouton in yet further view of Mook.

1. The cited references fail to disclose every element and limitation as recited in each of the rejected claims that depend from independent claims 1, 7 and 60.

As stated above, Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton fail to teach or suggest extrapolating the perimeter of the image of the golf ball and an image capture device consisting essentially of a single camera. Mook does not disclose extrapolating the perimeter of the image of the golf ball and/or an image capture device consisting essentially of a single camera. Thus, the rejection of claims 12-28, 62, 64, and 77-84, which are claims depending from one or more of claims 1, 7 and/or 60 is improper as each of the elements and limitations of the claims are not contained in the cited references.

Thus, none of the references, either alone or in combination, cited for the rejection of claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 teaches or suggests all of the elements of the rejected claims. Since a prima facie case of obviousness has not

been established, the rejection of claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 should be withdrawn.

2. **The cited references, when properly combined, do not disclose all of the elements and limitations of claims 34-51, 53-54, 56, 86-88 and 90-96.**

Claims 35-51, 53-54 and 56 depend from independent claim 34 which recites:

34. An apparatus for determining spin characteristics of a golf ball after impact with a golf club head comprising:
an image capture device consisting essentially of a single camera for capturing two or more images of the golf ball after impact with the golf club head; and
a processor connected with said image capture device;
wherein said golf ball has **at least one marking that is at least halfway circumambulatory of the surface of said golf ball** such that said marking is at least partially within the view of said camera for any rotational position of said golf ball when said images are taken; and
wherein said processor determines spin of said ball based on an automatic determination of at least one characteristic of only one of said markings on images captured only with said camera;
said at least one characteristic including curvature of said marking.

Claims 87-88 and 90-96 depend from independent claim 86 which recites:

86. A system for monitoring spin of a golf ball following impact by a golf club, the system comprising:
a golf ball having an elongated stripe thereon;
an image capture device consisting essentially of a single camera positioned to capture at least two images of the golf ball following impact by a golf club; and
a processor for finding the stripe in images captured only by the camera and for determining a spin of the ball based on at least one characteristic of the stripe in said images;
said at least one characteristic including curvature of said stripe.

a. When properly combined, the references fail to teach an imaging device consisting essentially of a single camera.

As mentioned above, Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton, when properly combined, fail disclose an image capture device consisting essentially of a single camera. Mook does not disclose an image capture device consisting essentially of a single camera. Thus, the rejection of claims 34-51, 53-54, 56, 86-88 and 90-96 is improper as each of the elements and limitations of the claims are not contained in the cited references.

b. The cited references fail to disclose determining the spin on the ball from the curvature of the stripe or marking.

Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton, fail to disclose utilizing a golf ball with a stripe or a marking that is at least half way circumambulatory of the golf ball. While Mook does disclose a golf ball with three stripes extending around the golf ball, it does not disclose a processor utilizing the curvature of the stripe in the determination of the spin of the golf ball. Instead Mook relies upon the eye of the golfer (a processor?) to determine the spin of the golf ball based upon the perceived color of the golf ball in flight. While there is some doubt whether a golfer would have keen enough eyes to pick up the perceived color, typically a golf ball in flight appears as a black dot against the background to the eye of the golfer) it is beyond human capacity for the golfer to perceive the curvature of the line. Thus, the cited combination fails to disclose all of the elements and limitations of the rejected claims.

- C. Claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 are patentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in further view of Bouton in yet further view of Katayama.**

The Examiner rejected claims 12-28, 34-51, 53-54, 56, 62, 64, 77-84, 86-88 and 90-96 as being unpatentable over Gobush '823 in view of Gobush '622, in further view of Sullivan in further view of Bouton in yet further view of Katayama.

- 1. The cited references cannot be properly combined to disclose every element and limitation as recited in each of the rejected claims that depend from independent claims 1, 7 and 60.**

As stated above, Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton fail to teach or suggest extrapolating the perimeter of the image of the golf ball and an image capture device consisting essentially of a single camera. Katayama does not teach utilizing an imaging device consisting essentially of a single camera. While Katayama does disclose that "the sideward launch angle of the ball 11 can also be calculated based on a difference in a ball diameter between an image of the golf ball 11 in the first display area 40A and that in the second display area 40 B" utilizing a two camera system rather than a three camera system, Katayama, contrary to the teaching of Gobush '622 and Sullivan captures a complete picture of the golf ball rather than only the retroreflective material attached to the golf ball. Thus, Gobush '622 and Sullivan, with their emphasis on eliminating, suppressing or ignoring all data except that attributable to reflections from the retroreflective spots teaches away from being combined with Katayama.

- 2. The cited references, when properly combined, do not disclose all of the elements and limitations of claims 34-51, 53-54, 56, 86-88 and 90-96.**

- a. When properly combined, the references fail to teach an imaging device consisting essentially of a single camera.**

As mentioned above, Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton, when properly combined, fail disclose an image capture device consisting essentially of a single camera. Katayama does not disclose an image capture device consisting essentially of a single camera. Thus, the rejection of claims 34-51, 53-54, 56, 86-88 and 90-96 is improper as each of the elements and limitations of the claims are not contained in the cited references.

- b. The cited references fail to disclose determining the spin on the ball from the curvature of the stripe or marking.**

Gobush '823 in view of Gobush '622, in further view of Sullivan and further in view of Bouton, fail to disclose utilizing a golf ball with a stripe or a marking that is at least half way circumambulatory of the golf ball. While Katayama does disclose a golf ball with two stripes extending around the golf ball, it does not disclose a processor utilizing the curvature of the stripe in the determination of the spin of the golf ball.

Instead Katayama states:

Reference numeral 60e denotes a line marked on the golf ball 11 along the equator thereof, and numeral 60f denotes a line marked on the ball 11 perpendicularly to the line 60e (sic.). For example, a change in the angle of the line 60e between the first display area 40A and the second display area 40B is measured, Then based on the thus-measured change of the angle and the time t3 (Fig. 3), the amount of backspin (angular velocity) is obtained. Further, through the measurement of the movement of a certain point on the spherical surface of the ball 11 (this movement appears in the form of a difference in the appearance between the first and second display areas 40A

and 40 B), the amount of side spin can be obtained likewise. Katayama Col 4, ll 14-26

Thus, Katayama fails to even mention the curvature of the line or marking and thus fails to utilize this characteristic of the image of the stripe or marking on the ball to determine spin on the ball.

Conclusion

Based on the foregoing, Applicant respectfully submits that claims 1-28, 33-51, 53, 54, 56-60, 62, 64, 65, 67, 68, 77-84, 86-88 and 90-96 are in condition for allowance. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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